

# New Tanaidacea (Crustacea: Peracarida) from the Gulf of Guinea

Piotr Józwiak<sup>1</sup> · Magdalena Janicka<sup>1</sup> · Paulina Dębiec<sup>1</sup> · Andrzej Stępiński<sup>1</sup> ·  
Katarzyna Mielczarz<sup>1</sup> · Bjørn Serigstad<sup>2</sup> · Magdalena Błażewicz<sup>1</sup>

Received: 13 September 2016 / Revised: 22 January 2017 / Accepted: 24 January 2017  
© The Author(s) 2017. This article is published with open access at Springerlink.com

**Abstract** Four new species of deep-sea Tanaidacea taken from the Gulf of Guinea as part of the Ghanaian marine environmental monitoring programme in 2012 are described. One of the species, which was classified to the family Anarthruridae, differed substantially from the other members of the family, and was accommodated to the newly erected genus – *Olokun* n. gen. Each of the three other species belongs to a different family: *Parakanthophoreus guineus* n. sp. – Akanthophoreidae, *Collettea agnesi* n. sp. – Colletteidae, and *Araphura studens* n. sp. – Tanaellidae. A key for genera of Anarthruridae is given.

**Keywords** Tanaidacea · Ghanaian coast ·  
*Parakanthophoreus* · *Olokun* n. gen · *Collettea* · *Araphura*

## Introduction

Studies on the West African Tanaidacea date back to the end of the nineteenth century, when *Pseudoleptochelia inermis* (Dollfus 1898) was described. Since that time only about 80 species of tanaidaceans were recorded from the Atlantic coast of Africa. The main contributors in the field were Barnard

(1914a, b, 1920, 1935) and Brown (1954, 1956a, b, 1957a, b, and 1958), who efficiently concentrated their research on South African fauna. Barnard described nine new species from the families Apseudidae, Metapseudidae, Pagurapseudopsidae, Paratanaidae, and Tanaididae, while Brown described nine species from the families Parapseudidae, Pagurapseudopsidae, and Leptocheilidae. The other important contribution was provided by Lang, who has redescribed *Apseudopsis acutifrons* (Sars, 1882) based on the collection made during the R/V *Atlantidae* cruise (Lang 1956) and has described *Kalliapseudes magnus* Lang, 1956 and *Hemikalliapseudes hanstroemi* Lang, 1956 from the material taken during the R/V *Galathea* cruise (Lang 1956).

The most recent studies on West African Tanaidacea were related to Macaronesian Islands and closer to the equatorial part of the West African coast in the Gulf of Angola. For example, a total of ten species from the families Parapseudidae, Leptocheilidae, Nototanaididae, Paratanaidae, Pseudotanaididae, Tanaididae, and Typhlotanaididae were described from Canary, Selvagen, and Cape Verde Islands (Bamber 2012; Larsen 2012; Larsen et al. 2012). For the Gulf of Angola, Bamber (2000) described a new species of *Collettea* – *C. pegmata* Bamber, 2000 and Bochert (2012) described *Apseudopsis cuanzanus* Bochert, 2012, *Hemikalliapseudes sebastiani* Bochert, 2012 and *Calozodion dominiki* Bochert, 2012. Furthermore, a series of publications was an outcome of the DIVA-1 (Diversity of Atlantic) Expedition to the Angola Basin, when ten species were described (Guerrero-Kommritz 2003a, b, 2004; Guerrero-Kommritz and Heard 2003; Guerrero-Kommritz and Błażewicz-Paszkowycz 2004; Guerrero-Kommritz et al. 2002).

Further north from the Gulf of Angola, e.g. in the Gulf of Guinea, tanaidaceans have hardly ever been studied. Until now, only six species of Tanaidacea were recorded there, namely *Apseudopsis acutifrons* (Sars, 1882) (Lang 1955), *Neotanais rotermundiae* Weigmann & Guerrero-Kommritz,

Communicated by S. S. M. Kaiser

This article is registered in ZooBank under urn:lsid:zoobank.org:pub:F5238F3F-9B30-45E1-ABCF-49E6C6F9C860

✉ Piotr Józwiak  
pjozwiak@biol.uni.lodz.pl

<sup>1</sup> Laboratory of Polar Biology and Oceanobiology, University of Łódź, Banacha 12/16, 90-237 Łódź, Poland

<sup>2</sup> Bergen Department, Institute of Marine Research, Nordnesgaten 50, 5005 Bergen, Norway

2009 (Weigmann and Guerrero-Kommritz 2009), and recently described from *Lophelia* rubble (Jakiel et al. 2015): *Calozodion pabisi* Jakiel & Józwiak, 2015 *Bathyleptochelia chingilingi* Stępień & Jakiel, 2015, *Cryptocopoides obaloba* Józwiak & Błażewicz-Paszkowycz, 2015, and *Pseudotanais artoo* Błażewicz-Paszkowycz & Stępień, 2015.

The collection of benthic samples made as part of the Ghanaian marine environmental monitoring programme (Serigstad et al. 2015) is extremely extensive, and its complete sorting will take a few years. Nevertheless, the completed sorting of the first sets of samples has revealed numerous new species, most of which are apparently represented by single specimens. In this collection, the four species were represented by more than one specimen, and their descriptions are presented in this paper.

## Materials and methods

The samples were collected in October and November 2012 in the Gulf of Guinea off Ghana from the RV *Dr Fridtjof Nansen* (Fig. 1). The cruise was a part of the marine environmental monitoring programme organised in co-operation between the Institute of Marine Research in Bergen (Norway) and the Environmental Protection Agency (Ghana). The sampling programme was supported by the Norwegian Agency for Development Cooperation (NORAD) (Oil for Development Programme – OfD) and the Food and Agriculture Organization of the United Nations (FAO). The project aimed to assess the influence of oil industry on marine benthic fauna in this almost completely unstudied part of the World Ocean. A total of 400 samples were taken on nine transects from the littoral to 1600 m depth, using a 0.2 m<sup>2</sup> van Veen grab. The material was sieved on 0.3 mm mesh size.

Tanaidacean specimens were dissected using chemically sharpened tungsten needles, mounted in glycerin on slides and sealed with nail varnish. Drawings were initially prepared using a microscope combined with a camera lucida and then

re-drawn on a digital tablet (as proposed by Coleman 2003). The body length to width ratio was calculated using measurements from the tip of the carapace to the end of the pleotelson, and of the widest part of carapace, while the length and width of articles were measured along their central axes. The morphological terminology follows that proposed by Błażewicz-Paszkowycz et al. (2013). The material is deposited at the University Museum of Bergen (Norway).

## Systematics

Suborder Tanaidomorpha Sieg

Superfamily Paratanaoidea Lang

Family Akanthophoreidae Sieg, 1986

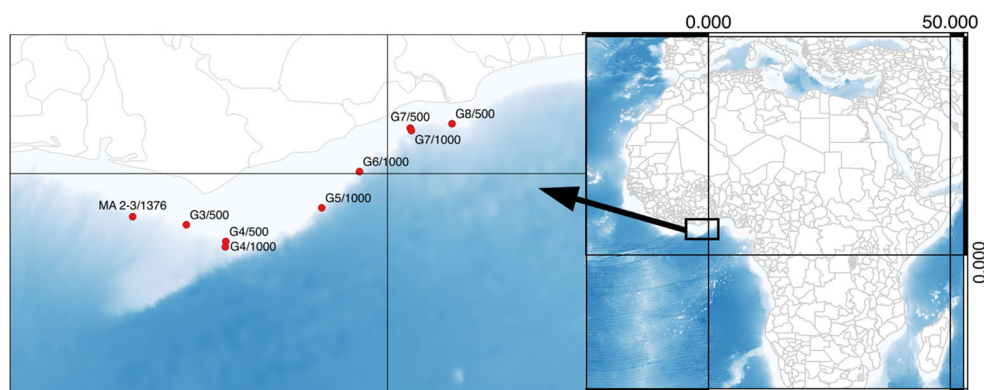
Genus *Parakanthophoreus* Larsen & Araujo-Silva, 2014

*Parakanthophoreus guineus* n. sp. Józwiak & Stępiński (Figs 2–4)

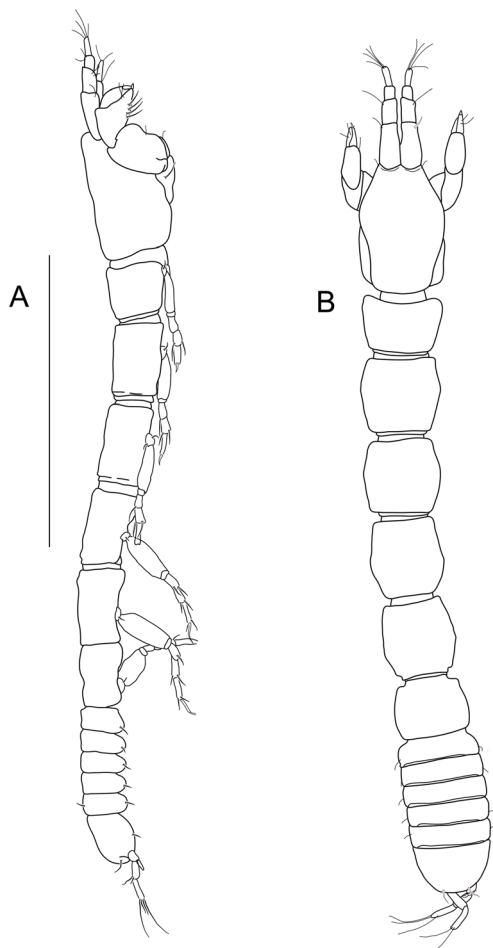
Materials examined: holotype non-ovigerous female, 2.7 mm long (ZMBN 116018) st. G4/1000, sample 6, 4°10' 18.48"N 1°50'23.28"W, depth 993 m, 20 November 2012; paratype: one non-ovigerous female dissected on slides (ZMBN 116019) st. G4/500, sample 4, 4°13'58.44"N 1°50' 1.68"W, depth 497 m, 20 November 2012; one non-ovigerous female partly dissected, 2.6 mm (ZMBN 116020) st. G4/500, sample 4, 4°13'58.44"N 1°50'1.68"W, depth 497 m, 20 November 2012; one non-ovigerous female, 2.5 mm (ZMBN 116021 st. G4/500, sample 8, 4°13'58.44"N 1°50' 1.68"W, depth 497 m, 20 November 2012; one non-ovigerous female, 1.7 mm (ZMBN 116022) st. G3/500, sample 4, 4°25'17.76"N 2°16'54.12"W, depth 509 m, 19 November 2012.

Diagnosis

Maxilliped basis with long seta; endites with distinct distal tubercle and single seta. Cheliped carpal shield well-developed; propodus covered with microtrichiae; carpus and dactylus without crenulation; fixed finger with four serrated setae on ventral margin.



**Fig. 1** Location of the sampling site

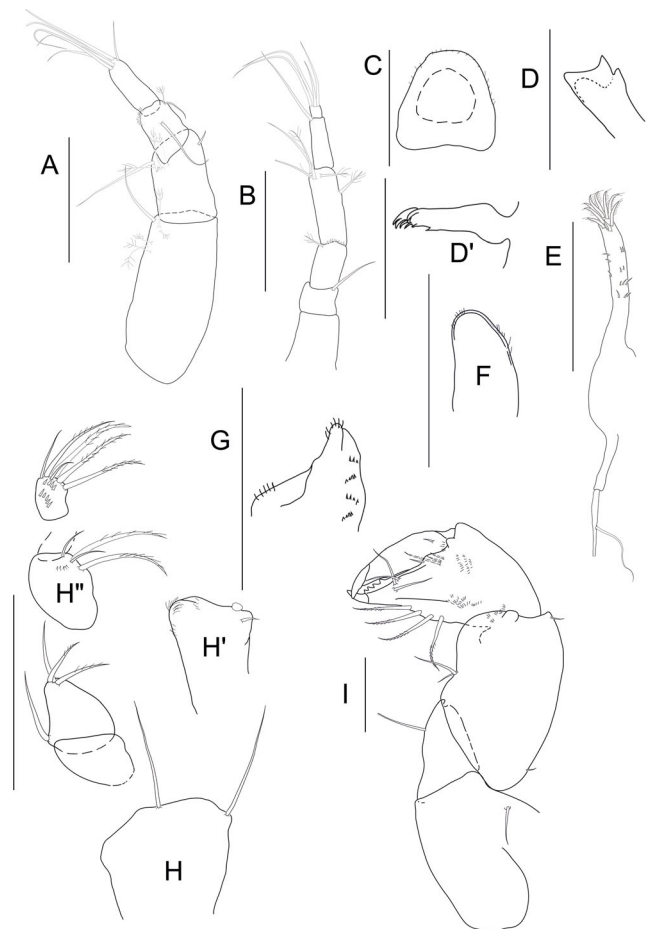


**Fig. 2** *Parakanthophoreus guineus* n. sp. female holotype (ZMBN 116018), habitus. A lateral view; B dorsal view. Scale bar: 1 mm

**Etymology:** species is named after its type locality Gulf of Guinea (adjective).

**Description of female holotype:** body (Fig. 2A and B) slender, about eight times as long as wide. Cephalothorax almost 20% of total body length. Pereonite 1 about 0.4 times as long as cephalothorax, about 0.6 times as long as wide, with concave anterior margin; pereonites 2 to 5 subequal, almost as long as wide, wider in the middle part; pereonite 6 shorter than the previous pereonites, about 0.8 times as long as wide. Pleon 20% of total body length. Pleonites subequal, about 0.2 times as long as wide, with simple seta laterally; sterna rounded in lateral profile. Pleotelson about 30% of total length of pleon, tapering distally.

**Antennule** (Fig. 3A) of four articles, proximal article elongate, 2.2 times as long as wide, about 0.7 times as long as distal three articles combined, subdistally with group of six outer setae – one simple, the others penicillate; second article about 1.6 times as long as wide, about 0.5 times as long as proximal article, distally with six setae, three penicillate and two simple outer setae (one broken) and one inner simple seta; third article almost as long as wide, with one long simple seta



**Fig. 3** *Parakanthophoreus guineus* n. sp. female paratype (ZMBN 116019) A antennule; B antenna; C labrum; D right mandible incisor; D' right mandible molar process; E maxillule; F maxilla; G labium; H maxilliped bases; H' maxilliped endite; H'' maxilliped palp; I cheliped. Scale bars: 0.1 mm for A, B and E–I, 0.05 mm for C–D'

in middle, inner distal row of spinules, one simple and one penicillate inner distal setae; fourth article about 2.8 times as long as wide, with one aesthetasc and five distal simple setae.

**Antenna** (Fig. 3B) proximal article naked; second article about 0.7 times as long as wide, with one distal simple seta; third article about 1.7 times as long as wide, with outer distal penicillate seta and row of spinules on distal margin; fourth article longest, about 2.8 times as long as wide, with distal three penicillate and with two long and one short simple setae; fifth article 3.5 times as long as wide, with distal simple seta; sixth article smallest, with four distal simple setae.

**Mouthparts.** Labrum (Fig. 3C) simple, hood-shaped and setulose. Right mandible (Fig. 3D) incisor flattened distally, two teeth on anterior corner; molar process (Fig. 3D') slender, tapering distally, with numerous distal spines. Left mandible lost during dissection. Maxillule (Fig. 3E) with eight serrated and one simple setae, distolateral margins with microtrichiae; palp with two simple setae. Maxilla (Fig. 3F) simple, oval and setose. Labium (Fig. 3G) simple, inner and outer lobes with spinules. Maxilliped (Fig. 3H) basis with simple long seta

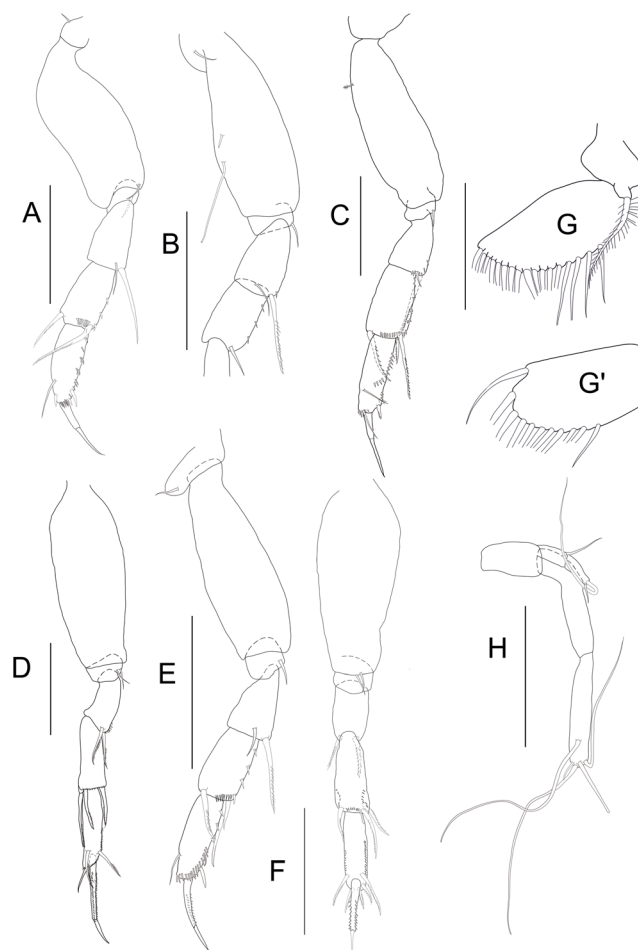
distally. Maxilliped endite (Fig. 3H') with outer distal group of microtrichiae one simple inner distal seta and tubercle. Maxilliped palp (Fig. 3H'') first article naked; second article with two plumose and one simple inner setae and one outer simple seta; third article with distal microtrichiae and four inner setae, two serrated and two simple; fourth article smallest, with microtrichiae, one subdistal seta and group of five distal setae, four of them serrated and one simple.

Cheliped (Fig. 3I) basis with rounded posterior part just longer than anterior part, dorsodistally with simple seta; merus about 1.1 times as long as wide, with one ventral seta; carpus about 1.4 times as long as wide, with two ventral simple setae at midlength, two dorsal simple seta, one proximal and one distal, and well-developed carpal shield; propodus robust, palm longer than wide, with four ventral serrated setae, group of three spines near dactylus insertion on inner surface, single distal seta near dactylus insertion on outer surface and numerous microtrichiae; fixed finger with three simple setae and four well calcified teeth on cutting edge.

Pereopod 1 (Fig. 4A) coxa with one seta; basis 2.3 times as long as wide, with one simple ventrodistal seta; ischium with one ventrodistal seta; merus widening distally, about 1.8 times as long as wide, as long as carpus, with two ventrodistal simple setae, one strong and one simple; carpus about 1.7 times as long as wide, with microtrichiae on ventral and distal margins, one ventrodistal serrated seta and one dorsodistal serrated seta; propodus about 2.7 times as long as wide, with paired spinules on ventral and distal margin, one ventrodistal spine, one dorsodistal spine and one subdistal simple seta on dorsal margin; dactylus naked, unguis about 1.2 times as long as dactylus, combined about as long as carpus.

Pereopod 2 (Fig. 4B) coxa with simple seta; basis 2.5 times as long as wide, with two penicillate setae dorsally at midlength; ischium with one ventrodistal simple seta; merus widening distally, about 1.7 times as long as wide, ventrodistally with one serrated seta and one spinule, one simple ventrodistal seta; carpus about 1.6 times as long as wide, with spinules on ventral margin and one ventrodistal simple seta, dorsodistal seta broken; propodus about three times as long as wide, with microtrichiae on ventral margin, serrated spine ventrodistally, dorsal penicillate seta and dorsodistal row of spinules and one simple seta (broken on figure, observed from holotype).

Pereopod 3 (Fig. 4C) basis about 2.8 times as long as wide, with one dorsal penicillate seta proximally; ischium with one ventrodistal simple seta; merus with ventrodistal spinules, one strong serrated and one simple ventrodistal setae; carpus about 1.9 times as long as wide, with ventral microtrichiae, two ventrodistal serrated setae, distal microtrichiae and dorsodistal serrated seta; propodus three times as long as wide, with microtrichiae on ventral margin, ventrodistally with serrated spine, dorsodistally with group of spinules and one simple seta, and dorsally with penicillate seta; dactylus naked, unguis



**Fig. 4** *Parakanthophoreus guineus* n. sp. female paratype (ZMBN 116019) A pereopod 1; B pereopod 2; C pereopod 3; D pereopod 4; E pereopod 5; F pereopod 6; G pleopod basis and exopod; G' pleopod endopod; H uropod. Scale bars: 0.1 mm

1.4 times as long as dactylus, combined about as long as carpus.

Pereopod 4 (Fig. 4D) coxa broken off; basis about 2.3 times as long as wide, naked; ischium with two ventral simple setae; merus with two ventrodistal serrated setae and microtrichiae; carpus three times as long as wide, with microtrichiae on distal margin, one ventrodistal serrated seta and two dorsodistal serrated setae; propodus about 4.2 times as long as wide, with microtrichiae from midlength ventral margin to distal margin, one dorsodistal simple seta and two serrated ventrodistal setae; dactylus with two rows of spinules on ventral margin; unguis about 0.4 times as long as dactylus.

Pereopod 5 (Fig. 4E) coxa with one simple seta; basis about 2.8 times as long as wide, naked; ischium with one simple ventrodistal seta (probably the other broken); merus with one ventrodistal serrated seta and one simple distal seta; carpus 1.3 times as long as wide, with spinules and two simple strong setae on ventral margin and one dorsodistal serrated seta; propodus about 3.1 times as long as wide, with spinules



on ventral and distal margins, one ventrodiscal strong spine and one dorsal simple seta; dactylus with two rows of spinules, unguis 0.4 times as long as dactylus.

Pereopod 6 (Fig. 4F) basis 2.4 times as long as wide, slightly wider proximally, naked; ischium with two simple ventrodiscal setae; merus 1.25 times as long as wide, with two serrated ventrodiscal setae; carpus 2.6 times as long as wide, with ventrodiscal and distal microtrichiae, one simple and two serrated setae ventrodistally, and one serrated seta dorsodistally; propodus about 3.6 times as long as wide, with ventral microtrichiae beginning at two-thirds length and two serrated ventrodiscal setae and three serrated dorsodiscal setae; dactylus with two rows of spinules ventrally; unguis about 0.4 times as long as dactylus.

Pleopods (Fig. 4G, G') endopod with one seta subdistally on dorsal margin and ten setae distally; exopod with one proximal seta and 17 setae ventrally and distally, all setae plumose.

Uropod (Fig. 4H) biramous, basis naked; exopod of two segments, together about 0.2 times as long as endopod, proximal segment with one distal simple seta, distal segment with one long and one short simple setae distally; endopod of two segments, proximal segment naked, distal segment with five simple distal setae.

#### Remarks

According to the recent re-definition of taxa classified in the Akanthophoreidae (Larsen and Araújo-Silva 2014), *Parakanthophoreus guineus* n. sp. that lacks spurs on pleonite 5 (ventrally), on the pleotelson (laterally), and on the basis and segment 1 of the endopod of the uropods, but has the basis of pereopods 1–3 of same width as pereopods 4–6, can be classified to the genus *Parakanthophoreus* Larsen & Araújo-Silva, 2014 or *Paraleptognathia* Kudinova-Pasternak, 1981. Although the new species has ornamentation on the propodus of the chela – a character proposed as diagnostic for *Paraleptognathia*, we have decided to classify it in *Parakanthophoreus*, as it lacks ornamentation on the cheliped fixed finger and the carpus, and lacks proximal denticulation on the fixed finger.

The unique character distinguishing *P. guineus* from not only other *Parakanthophoreus* species but also other akanthophoreids is a presence of the four serrated spines on the ventral margin of the fixed finger. Most species of Akanthophoreidae have their fixed finger armed with two setae (e.g. *Akanthophoreus phillipsi* (Sieg & Dojiri, 1991)) or two spines (e.g. *Stenotanais crassiseta* Bird & Holdich, 1984) (Sieg and Dojiri 1991; Bird & Holdich 1984), and the only two akanthophoreids with more than two setae/spines on their fixed finger are *P. vikingra* Błażewicz-Paszkowycz & Bamber, 2011 with three setae and an undescribed species (Błażewicz-Paszkowycz and Bamber 2011), provisionally classified as *Chauliopleona armata* sensu lato with five serrated spines (Bird 2015).

*Parakanthophoreus guineus* can be also distinguished from its congeners by the combination of:

- a presence of long setae on the maxillipedal bases. In *P. brachiatus* (Hansen, 1913), *P. greenwichius* Larsen & Araújo-Silva, 2014, *P. inermis* (Hansen, 1913), *P. longiremis* (Lilljeborg, 1864), *P. nanopsenos* (Bamber & Bird, 2009), and *P. tenuichelus* (Guerrero-Kommritz, 2004) long setae on (Bamber et al. 2009; Guerrero-Kommritz 2004; Hansen 1913; Larsen and Araújo-Silva 2014; Lilljeborg 1864);
- a well-developed carpal shield. A weakly developed shield is observed in: *P. albus* (Hansen, 1913), *P. antarcticus* (Vanhöffen, 1914), *P. crassicaudus* (Bird, 2007), *P. fastuosus* (Guerrero-Kommritz, 2004), *P. multiserratoides* (Guerrero-Kommritz, 2004), *P. tenuichelus*, and *P. verutus* (Błażewicz-Paszkowycz, Bamber and Józwiak, 2013) (Bird 2007a; Błażewicz-Paszkowycz et al. 2013; Guerrero-Kommritz 2004; Hansen 1913; Larsen and Araújo-Silva 2014; Lilljeborg 1864; Vanhöffen 1914); in *P. nanopsenos* a shield is absent (Bamber et al. 2009);
- a cheliped propodus with microtrichiae. This character is absent in all members of *Parakanthophoreus*, although it needs to be treated with caution as it could be overlooked or not described properly in previous studies;
- a cheliped carpus, propodus and dactylus without crenulation. A crenulate carpus is recorded in *P. multiserratus* (Hansen, 1913) and *P. multiserratoides* (Guerrero-Kommritz 2004; Hansen 1913); a crenulate propodus was observed in: *P. australis* (Beddard, 1886), *P. bisetulosa* (Dojiri & Sieg, 1997), *P. multiserratus*, *P. multiserratoides*, and *P. vikingra* (Błażewicz-Paszkowycz & Bamber, 2011); (Błażewicz-Paszkowycz and Bamber 2011; Dojiri and Sieg 1997; Guerrero-Kommritz 2004; Hansen 1913); crenulation on the dactylus is present in *P. antarcticus*, *P. australis*, *P. multiserratus*, *P. multiserratoides*, *P. verutus*, and *P. vikingra* (Błażewicz-Paszkowycz and Bamber 2011; Błażewicz-Paszkowycz et al. 2013; Guerrero-Kommritz 2004; Hansen 1913; Vanhöffen 1914).

Family Anarthruridae Lang, 1971

Genus *Olokun* n. gen. Józwiak & Błażewicz

Gender: female

Type species: *Olokun puellamaritima* n. sp. by monotypy

Diagnosis

Cephalothorax short and rounded. Pleotelson well-developed, pleonites not fused. Labrum relatively large, not laterally compressed. Maxillule with six distal spines. Article 2 of maxillipedal palp with one seta; article 3 with one simple and three strong inner setae. Cheliped propodus/fixed finger with lateral fold and row of six serrated spines. Pereopods 1–3 coxa

with seta. Pereopods 4–6 basis stout and swollen, about 1.6–1.7 times as long as wide; ischium with two ventrodistal setae; merus and carpus short and stout; propodus shorter and distinctly narrower than carpus; dactylus not fused with unguis. Pleopods well-developed, exopod with setae along ventral and distal margin. Uropod endopod two-segmented; exopod vestigial, fused with basis, with three setae distally.

**Etymology:** named after Olokun the West African, Yoruban goddess of the Ocean.

#### Remarks

The row of strong serrated spines presents on the cheliped propodus/fixed finger ventral margin in *Olokun* n. gen. is a unique character among Anarthruridae and similar to unique multiple meral setation of cheliped in *Crenicarpus* Drumm & Bird, 2016 (Drumm and Bird 2016) adds more morphological diversity. Furthermore, this genus can be distinguished from other genera of this family by the combination of:

- a conical labrum. A laterally compressed labrum is present in *Anisopechys* Bird, 2004 (Bird 2004), *Synarthrura* Bird, 2004 and *Siphonolabrum* Lang, 1972 (Bird 2004, 2007b; Lang 1972);
- a maxillule endite with six spines. *Acinoproscelos* Bamber & Błażewicz-Paszkowycz, 2013 and *Anarthrura* Sars, 1882 have four setae on the maxillule endite, *Anarthruella* Bird, 2004 (at least) three spines, *Anarthruopsis* Lang, 1968 and *Synarthrura* five spines, *Anisopechys* Bird, 2004 and *Ithyomus* Bird, 2004 seven spines, *Cristatotanaïs* Kudinova-Pasternak, 1990 from four to eight spines, while *Keska* Błażewicz-Paszkowycz, Bamber & Józwiak, 2013 and *Siphonolabrum* Lang, 1972 have up to eight spines (Bird 2004, 2007b; Bamber and Błażewicz-Paszkowycz 2013; Błażewicz-Paszkowycz et al. 2013; Kudinova-Pasternak 1990; Lang 1968, 1972; Sars 1882);
- a single seta on maxilliped palp article 2. A presence of only one seta on article 2 of maxilliped palp was recorded so far only for *Keska* (Błażewicz-Paszkowycz et al. 2013);
- article 3 of maxillipedal palp with three inner setae. In *Acinoproscelos*, there are six setae and in *Thorkelius* Bird, 2004 four setae (Bamber and Błażewicz-Paszkowycz 2013; Bird 2004);
- a lateral fold on the cheliped propodus. This feature is absent in: *Acinoproscelos*, *Anarthrura*, *Anarthruopsis*, *Cristatotanaïs*, *Ithyomus*, *Keska*, *Siphonolabrum*, and *Thorkelius* (Bird 2004, 2007b; Bamber and Błażewicz-Paszkowycz 2013; Błażewicz-Paszkowycz et al. 2013; Kudinova-Pasternak 1990; Lang 1968, 1972; Sars 1882).
- the basis of pereopods 4–6 swollen, about 1.5 times as long as wide. The swollen basis of pereopods 4–6 was previously recorded e.g. for *Synarthrura* (Bird 2004) but never to this extent;
- the propodus of pereopods 4–6 compact and shorter than the dactylus/unguis combined. In Anarthruridae, the dactylus/unguis of pereopods 4–6 is usually short (compared to with this of pereopods 1–3), thus in most genera of this family the propodus of pereopods 4–6 is longer than the dactylus/unguis combined. *Ithyomus*, *Keska*, and *Siphonolabrum* are the only exception – as some of their species have the dactylus/unguis as long as propodus or just longer (Bird 2004; Błażewicz-Paszkowycz et al. 2013; Lang 1972);
- the uropod endopod two-segmented. A uni-segmented uropod is characteristic for *Anisopechys*, *Synarthrura*, and *Thorkelius* (Bird 2004).

#### Key to genera of Anarthruridae (supplemented after Drumm and Bird 2016)

1. Labrum narrow or elongate-conical (laterally compressed) . . . . . 2
  - Labrum conical, not elongate . . . . . 4
2. Labrum elongate-conical, reaching end of antenna article 3.
  - 3. Maxillule with five terminal spiniform setae . . . . . *Anarthruopsis*
    - Labrum narrow, not reaching end of antenna article 3. Maxillule with more than five terminal spiniform setae . . . 3
  - 3. Maxilliped endite with one pair of distal setae. Uropod basal process with two setae. . . . . *Siphonolabrum*
    - Maxilliped endite without setae. Uropod basal process with three setae . . . . . *Anisopechys*
4. Labrum distally setose. Maxilliped palp article 3 with six long inner setae. . . . . *Acinoproscelos*
  - Labrum not distally setose. Maxilliped palp article 3 with three or four long inner setae . . . . . 5
5. Cheliped propodal palm with lobe or fold . . . . . 6
  - Cheliped propodal palm without lobe or fold . . . . . 9
6. Cheliped merus with cluster of setae, carpus crenulate, propodal lobe extending onto portions of fixed finger and dactylus. Uropod basal process with two setae . . . . . *Crenicarpus*
  - Cheliped merus without cluster of setae, carpus not crenulate, propodal lobe or fold not extending onto portions of fixed finger and dactylus. Uropod basal process with three setae . . . . . 7
7. Cheliped propodus/fixed finger with row of six serrated spines on outer margin. . . . . *Olokun* n. gen.
  - Cheliped propodus/fixed finger without row of six serrated spines on outer margin. . . . . 8
8. Pereopods 4–6 with simple spiniform setae . . . . . *Anarthruella*
  - Pereopods 4–6 with complex spiniform setae. . . . . *Synanarthrura*
9. Pereopods 4–6 with simple spiniform setae. Cheliped fixed finger with one ventral seta. . . . . *Anarthrura*

- Pereopods 4–6 with complex spiniform setae. Cheliped fixed finger with two ventral setae . . . . .10
- 10. Maxilliped article-3 with four long inner setae. Pereopods 4–6 with three carpal spiniform setae . . . . .*Thorkelius*
- Maxilliped article-3 with three long inner setae. Pereopods 4–6 with four carpal spiniform setae . . . . .11
- 11. Maxilliped article-2 with one inner seta . . . . .*Keska*
- Maxilliped article-2 with three inner setae. . . . .*Ithyomus*

*Olokun puellamaritima* n. sp. Józwiak & Mielczarz  
(Figs 5–6)

Materials examined: holotype non-ovigerous female partly dissected, 3.2 mm long (ZMBN 116023) st. G7/1000, sample 8, 5°29'12.48"N 0°16'14.16"E, depth 972 m, 11 November 2012; paratype non-ovigerous female dissected on slides (ZMBN 116024) st. G8/500, sample 5, 5°33'49.68"N 0°43'55.2"E, depth 509 m, 7 November 2012.

Diagnosis: because *Olokun* n. gen. is monotypic, the diagnosis is the same as for the genus.

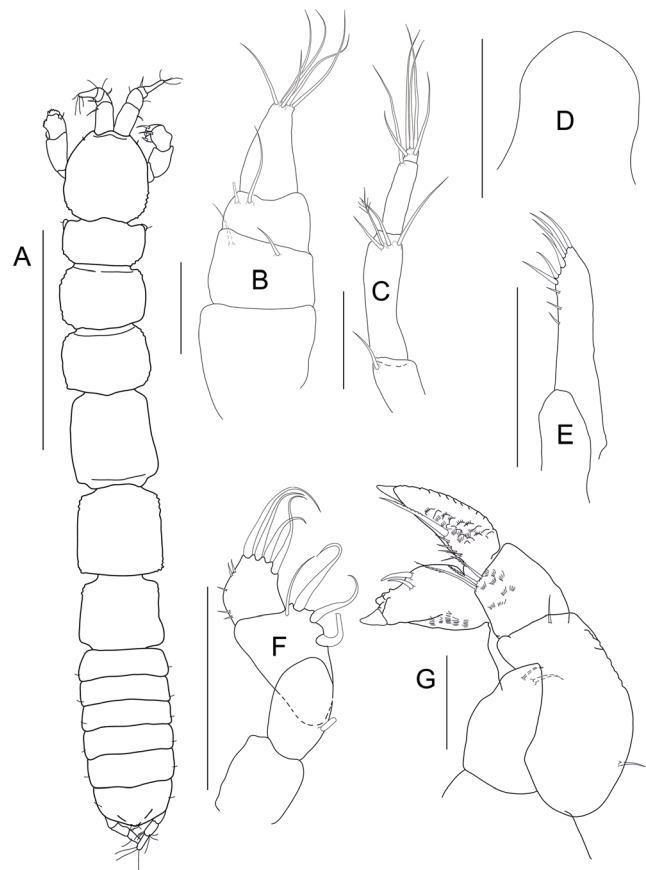
Etymology: *puella* [lat.] = girl and *maritima* [lat.] marine = mermaid reflect the common depiction of *Olokun* goddess.

Description of female holotype: body (Fig. 5A) slender, 8.3 times as long as wide. Cephalothorax about 10% of total body length, about 1.1 times as long as wide, with two simple dorsoproximal setae in distal part of lateral borders. Pereonite 1 about 0.5 times as long as wide, about 0.5 times as long as cephalothorax; pereonite 2 about 0.6 times as long as wide; pereonite 3 about 0.7 times as long as wide; pereonites 4 and 5 longest, about 1.2 times as long as wide; pereonite 6 about 0.9 times as long as wide. Pleon about 25% of total body length. Pleonites 1–4 subequal, about 0.3 times as long as wide; pleonite 5 slightly longer, about 0.4 times as long as wide. All pleonites with simple setae laterally. Pleotelson about 20% of total length of pleon, 0.4 times as long as wide, tapering towards distal part.

Antennule (Fig. 5B) of four articles, proximal article naked, proximally broken; second article 0.6 times as long as wide, with two distal simple setae; third article 0.7 times as long as article 2, distally with two simple outer setae (one broken); fourth article about one third as long as proximal three articles combined, distally with group of six simple setae.

Antenna (Fig. 5C) of six articles; first and second article broken; third article 1.1 times as long as wide, distally with simple seta; fourth article elongate, about 3.7 times as long as wide, distally with group of four setae, three simple and one penicillate; fifth article distally with inner simple seta; sixth article with group of five simple setae.

Mouthparts. Labrum (Fig. 5D) simple, rounded, without setae. Mandibles not recovered. Maxillule (Fig. 5E) distally with group of six spines and three setules on inner margin. Maxillipedal palp (Fig. 5F) first article naked; second article about 1.8 times as long as wide, with one midlength seta on

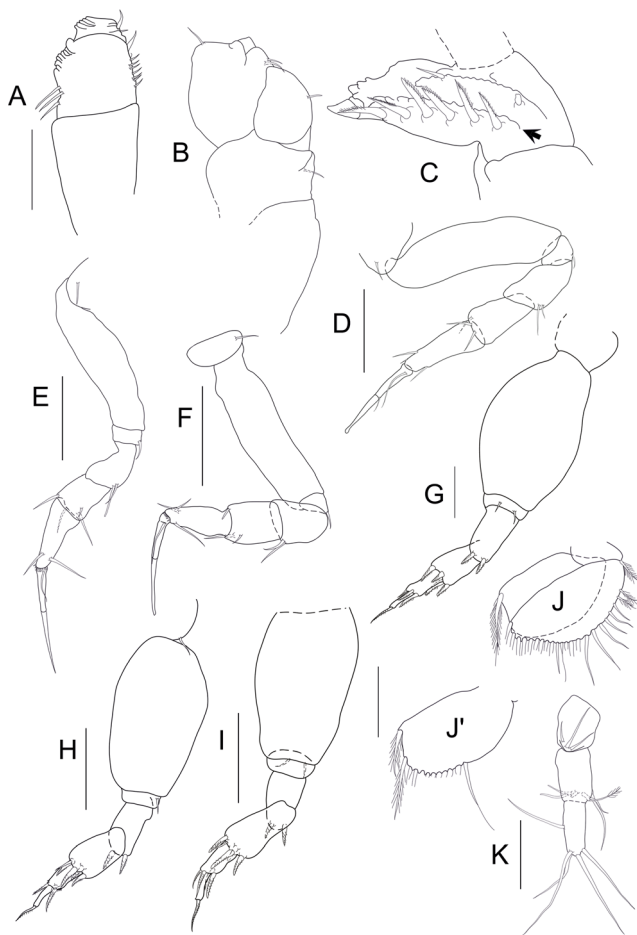


**Fig. 5** *Olokun puellamaritima* n. sp. A female holotype (ZMBN 116023) habitus, dorsal view; paratype female (ZMBN 116024) B antennule; C antenna; D labrum; E maxillule; F maxillipedal palp; G right cheliped. Scale bars: 0.1 mm

inner margin; third article about 1.9 times as long as wide, distally with one simple and three robust setae on inner margin; fourth article with four robust simple setae on distal margin and some spinules on outer margin.

Cheliped (Figs 5G, and 6A–C) basis naked; merus distally with two simple setae; carpus about 2.1 times as long as wide, with large posterior lobe overhanging merus, with one simple, subproximal and distal setae on dorsal margin; propodus with numerous microtrichiae and group of three serrated setae on inner face of palm, near dactylus insertion, one seta on outer face of palm, near dactylus insertion, lateral fold well-developed; propodus/fixed finger with six spines on outer margin and some microtrichiae, cutting edge with distal denticles and two robust setae; dactylus crenulate dorsally, with some lateral microtrichiae and one strong serrated seta and some spinules on ventral margin.

Pereopod 1 (Fig. 6D) coxa with single, simple seta; basis about 3.5 times as long as wide, naked; ischium with single simple seta on ventral margin; merus about 1.6 times as long as wide, ventrodistally with two simple setae; carpus about 1.9 times as long as wide, distally with group of three simple setae; propodus about 3.7 times as long as wide, with one



**Fig. 6** *Olokun puellamaritima* n. sp. female paratype (ZMBN 116024) A cheliped dorsal view; B basis, merus and carpus of left cheliped lateral view; C cheliped propodus and fixed finger, lateral fold marked with an arrow; D pereopod 1; E pereopod 2; F pereopod 3; G pereopod 4; H pereopod 5; I pereopod 6; J pleopod basis and exopod; J' pleopod endopod; K uropod. Scale bars: 0.1 mm

ventrodistal simple seta and two dorsodistal simple setae; dactylus about 0.5 times as long as propodus, about 4.6 times as long as wide, proximally with single simple seta and one seta on distal margin; unguis just longer than dactylus.

Pereopod 2 (Fig. 6E) coxa with simple seta; basis about 3.4 times as long as wide, naked; ischium with one ventrodistal seta; merus with two ventrodistal setae; carpus with four distal seta, one short and three long; propodus about 3.3 times as long as wide, with two long distal setae and row of spinules on distal margin; dactylus about 0.7 times as long as propodus, proximally with one simple seta; unguis about 1.4 times as long as dactylus.

Pereopod 3 (Fig. 6F) similar to pereopod 2, but with only three setae distally on carpus and propodus with additional dorsodistal seta.

Pereopod 4 (Fig. 6G) basis about 1.5 times as long as wide, swollen, naked; ischium with two simple ventrodistal setae; merus about two times as long as wide, distally with two ventral serrated spines; carpus about 1.9 times as long as wide,

distally with four serrated spines; propodus short slightly longer than wide with two ventrodistal serrated spines and one short dorsodistal seta; dactylus slightly shorter than propodus, naked; unguis same length as dactylus, with ventral serration.

Pereopod 5 (Fig. 6H) coxa with one seta; basis naked; ischium with one ventral seta; merus about 1.9 times as long as wide, distally with two serrated spines; carpus about 1.7 times as long as wide, distally with four serrated spines and one simple seta; propodus distally with two serrated spines and some spinules; dactylus naked, dactylus and unguis subequal, unguis serrated ventrally.

Pereopod 6 (Fig. 6I) similar to pereopod 4, but with additional spine distally on propodus.

Pleopods (Fig. 6J, J') all alike; basis with one seta; endopod with one subdistal seta dorsally and ten setae distally and ventrally; exopod (Fig. 6j) with 22 simple setae on ventral and distal margins, all setae plumose.

Uropod (Fig. 6K) basal article 1.4 times as long as wide; basal process rudimentary, distally with three simple setae; endopod of two segments; first segment about 1.5 times as long as wide, with six distal setae, five simple and one penicillate; second segment about 2.4 times as long as wide, with one simple seta at midlength and four simple distal setae.

Family Colletteidae Larsen and Wilson, 2002

Genus *Collettea* Lang, 1973

*Collettea agnesi* n. sp. Błażewicz and Janicka (Figs 7–8)

Materials examined: holotype preparatory male partly dissected, 1.9 mm long (ZMBN 116025) st. G6/1000, sample 6, 5°1'22.8"N 0°19'3.72"W, depth 994 m, 11 November 2012; one copulatory male, 1.3 mm (ZMBN 116026) st. G5/1000, sample 6, 4°36'45.36"N 0° 44' 44.16"W, depth 1040 m, 13 November 2012; paratype non-ovigerous female dissected on slides (ZMBN 116027) st. G5/1000 4°36'45.36"N 0° 44' 44.16"W, depth 1040 m, 13 November 2012.

Diagnosis

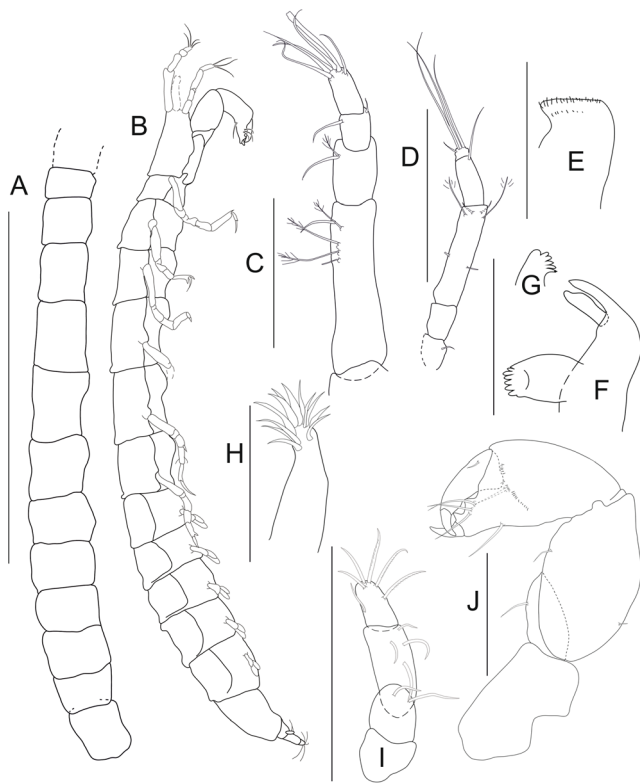
Pereonites 1–3 not subequal. Pleon longer than pereonites 4–6, pleotelson as long as pleonite 5. Cheliped fixed finger with single ventral seta and with two strong triangular teeth on cutting edge. Pereopods 2 and 3 unguis with subdistal ventral expansion. Uropods just longer than half of pleotelson; exopod shorter than half of endopod first article. Pereopods 4–6 merus carpus and propodus with strong spines.

Etymology: species is dedicated to Agnieszka Janicka-Maj, aunt of the second author, who has always supported that author and had a positive influence on her education.

The description of appendages was done based on a female and only antennule and antenna were taken from a preparatory male (damaged in the female).

Description: body (Fig. 7A, B) slender, about 16 times as long as wide. Cephalothorax 10% of total body length, tapering towards anterior part. Pereonite 1 shortest, one third as





**Fig. 7** *Collettea agnesi* n. sp. holotype male (ZMBN 116025) A habitus, dorsal view; B habitus lateral view; C antennule; D antenna; paratype female (ZMBN 116027) E labrum; F left mandible; G right mandible incisor; H maxillule; I maxilliped palp; J cheliped. Scale bars: 1 mm for A and B, 0.1 mm for C, D, I and J, 0.05 mm for E–H

long as cephalothorax; pereonites 2 and 3 subequal in length, about twice as long as pereonite 1; pereonites 4 and 5 subequal in length, about three times as long as pereonite 1; pereonite 6 shorter than pereonites 4 and 5. Pleon about 40% of total body length. Each pleonite longer than pereonite 1; pleonites 1–5 subequal and similar in length to pereonite 6. Pleotelson about 20% of total length of pleon, tapering towards posterior part.

Antennule (Fig. 7C) of four articles, proximal article elongate, 4.2 times as long as wide, about 1.3 times as long as distal three articles combined, with row of five outer setae, one simple and four penicillate; second article about 1.7 times as long as wide, about 0.4 times as long as first article, distally with one simple and one penicillate setae; third article shortest, almost as long as wide, distally with one inner and one short outer setae; fourth article about 1.8 times as long as wide, with five distal simple setae and one aesthetasc.

Antenna (Fig. 7D) of six articles. First article missing; second article with simple subdistal dorsal seta; third article naked; fourth article 4.1 times as long as wide, with two setae at midlength and two simple and two penicillate setae distally; fourth article half as long as third article, with simple distal seta; last article minute, with one short and three long simple setae.

Mouthparts. Labrum (Fig. 7E) distally finely setose. Left mandible (Fig. 7F) with pointed incisor, *lacinia mobilis* stout; molar process broad, with six teeth on distal margin. Right mandible (Fig. 7G) incisor with six denticles. Maxillule (Fig. 7H) with 12 distal spines. Maxillipedal palp (Fig. 7I) first article naked; second article with two strong inner setae; third article with four inner simple setae; fourth article with group of five distal setae (at least three of them serrated) and one outer seta at midlength.

Cheliped (Fig. 7J) basis about 1.8 times as long as wide, naked, posterior lobe subequal to anterior mass; merus suboval, with single ventral seta at midlength; carpus about 1.9 times as long as wide, with single ventrodorsal seta and single dorsal seta at one-third length; propodus palm longer than wide, with one seta and microtrichiae on inner side near dactylus insertion; fixed finger with single ventral seta and group of three inner simple setae and two triangular teeth on cutting edge; dactylus with one dorsoproximal seta.

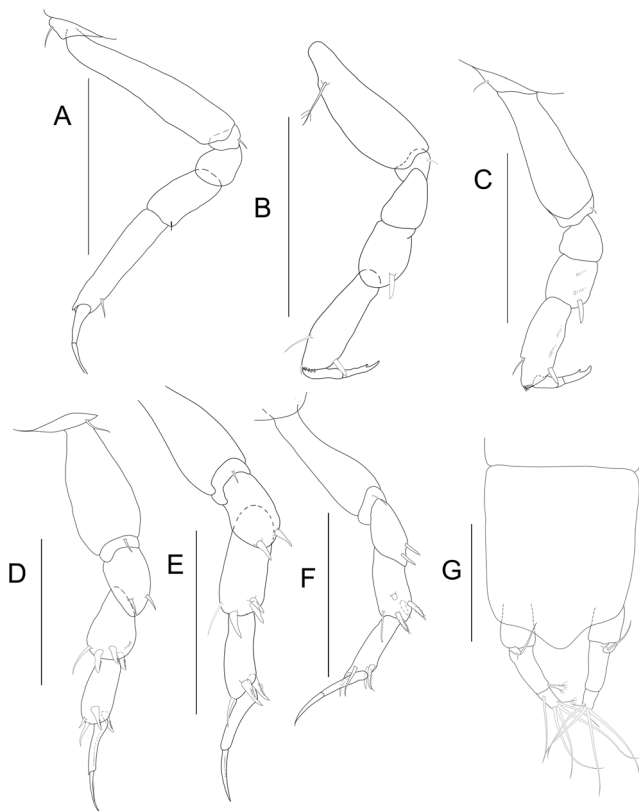
Pereopod 1 (Fig. 8A) coxa with single seta; basis slender, about 5.5 times as long as wide, naked; ischium with one ventral seta; merus almost as long as wide, naked; carpus subrectangular, twice as long as wide, with simple ventrodorsal seta; propodus tapering distally, about 3.8 times as long as wide, with one ventrodorsal spine; dactylus naked, unguis about 0.8 times as long as dactylus, both together about as long as carpus.

Pereopod 2 (Fig. 8B) basis about 2.9 times as long as wide, slightly swollen, with dorsoproximal penicillate seta; ischium with single ventral seta; merus subtriangular, about 1.2 times as long as wide, naked; carpus distally wider, 1.5 times as long as wide, with ventrodorsal spine; propodus 3.8 times as long as wide, with spinules on distal margin, one ventrodorsal spine and one dorsodorsal simple seta; dactylus naked, unguis equal in length to dactylus, with ventral spur.

Pereopod 3 (Fig. 8C) coxa with single seta; basis distally slightly wider, about 2.9 times as long as wide, naked; ischium with single ventral seta; merus as long as wide, naked; carpus as long as wide, with ventrodorsal spine and microtrichiae; propodus about 3.1 times as long as wide, with ventral microtrichiae, one ventrodorsal spine and one dorsal seta, distal margin with spinules; dactylus naked, unguis equal in length to dactylus, with ventral spur.

Pereopod 4 (Fig. 8D) coxa with single seta, basis distally wider, about twice as long as wide, naked; ischium with single ventral seta; merus about 1.6 times as long as wide, with two distal spines; carpus distally swollen and rounded, about as long as merus, with three serrated spines, one seta and microtrichiae distally; propodus 2.2 times as long as wide, with two serrated ventrodorsal spines and two dorsodorsal short spines; dactylus ventrally serrated, unguis pointed, slightly shorter than propodus, with ventral serration.

Pereopod 5 (Fig. 8E) similar to pereopod 4, but propodus lacks of one distal simple spine.



**Fig. 8** *Collettea agnesi* n. sp. female paratype (ZMBN 116027) A pereopod 1; B pereopod 2; C pereopod 3; D pereopod 4; E pereopod 5; F pereopod 6; G uropod. Scale bars: 0.1 mm

Pereopod 6 (Fig. 8F) similar to pereopod 4, but carpus with additional spine.

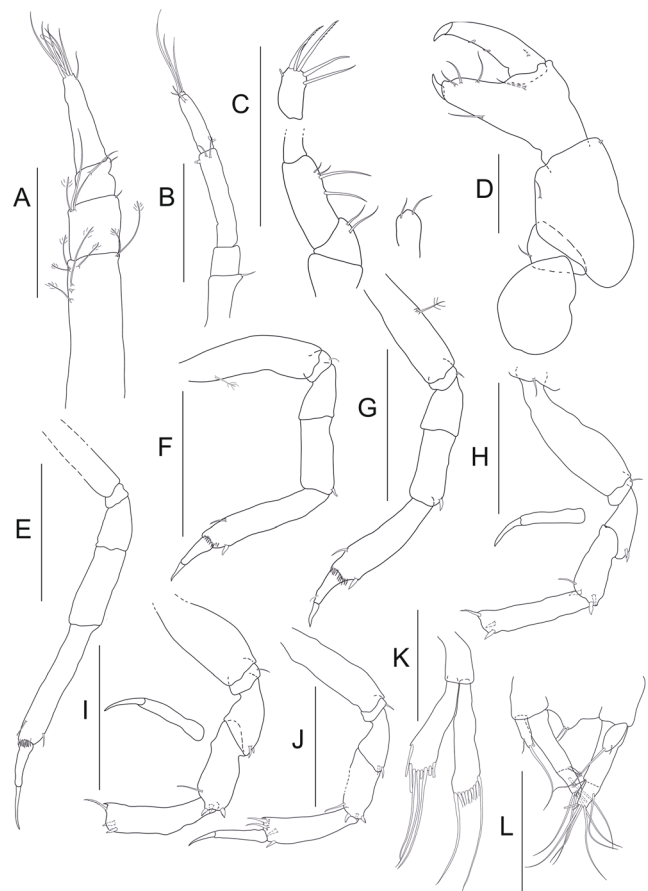
Pleopod (see on Fig. 7B) rami subequal in length, without setation.

Uropod (Fig. 8G) biramous, basal article naked; exopod unisegmented not reaching half of endopod first segment, with one long and one short distal setae; endopod of two segments; proximal segment with two penicillate setae distally, distal segment with one penicillate and five simple long setae.

Copulatory male:

Antennule (Fig. 9A) first article at least three times as long as wide, with three penicillate setae subdistally and five penicillate setae distally; second article about 0.4 times as long as first article, with one penicillate, two simple and one minute setae distally; third article about 0.6 times as long as second article, with one simple and one minute setae distally; fourth article three times as long as third article, with one aesthetasc and six simple setae.

Antenna (Fig. 9B) first article missing; second article twice as long as wide, with simple distal seta; third article as long as wide, naked; fourth article 5.2 times as long as wide, with one simple and one penicillate setae, one seta broken off; fifth article 0.6 times as long as fourth article, with one simple seta; distal article minute, with four simple setae.



**Fig. 9** *Collettea agnesi* n. sp. copulatory male (ZMBN 116026) A antennule; B antenna; C maxilliped; D cheliped; E pereopod 1; F pereopod 2; G pereopod 3; H pereopod 4; I pereopod 5; J pereopod 6; K pleopod; L uropod. Scale bars: 0.1 mm

Mouthparts strongly reduced.

Maxilliped (Fig. 9C) basis not observed; endite with two simple setae distally; palp first article trapezoidal, naked; second article triangular, with two simple inner setae; third article 2.4 times as long as wide, with two long and two short inner setae; distal article with one simple seta subdistally and three simple and two serrated setae distally.

Cheliped (Fig. 9D) basis short, about 1.4 times as long as wide, posterior lobe about as long as anterior mass, naked; merus triangular, with simple ventral seta; carpus 1.4 times as long as wide, with simple ventral and simple dorsodistal setae; propodus 1.8 times as long as wide, with one seta ventrally and one seta near dactylus insertion; fixed finger smooth, with three simple setae on cutting edge; dactylus about as long as fixed finger, with one short seta proximally and two spines on cutting edge.

Pereopod 1 (Fig. 9E) basis damaged; ischium naked; merus 1.7 times as long as wide, naked; carpus 1.7 times as long as merus, naked; propodus 1.6 times as long as carpus, with one seta dorsodistally, one ventrodistally and row of spinules distally; dactylus as long as unguis, combined just longer than carpus.

Pereopod 2 (Fig. 9F) basis 3.9 times as long as wide, with one dorsoproximal penicillate seta; ischium with seta; merus 0.3 times as long as basis, naked; carpus 1.6 times as long as merus, with short ventrodistal spine; propodus 1.7 times as long as carpus, with one dorsodistal seta, one ventrodistal spine and row of spinules distally; dactylus twice as long as unguis, combined half as long as propodus.

Pereopod 3 (Fig. 9G) similar to pereopod 2, but basis with two penicillate setae and dactylus with distal seta.

Pereopod 4 (Fig. 9H) coxa with seta; basis 3.5 times as long as wide, naked; ischium with seta; merus 0.3 times as long as basis, with two ventrodistal short spines; carpus 1.5 times as long as merus, with one seta and one spine dorsodistally and two serrated spines ventrodistally; propodus 1.4 times as long as carpus, with one serrated seta dorsodistally and two ventrodistal serrated spines; dactylus about twice as long as unguis, combined just shorter than propodus.

Pereopod 5 (Fig. 9I) as pereopod 4.

Pereopod 6 (Fig. 9J) basis 3.6 times as long as wide, naked; ischium with seta; merus 0.4 times as long as basis, with two spines ventrodistally; carpus just longer than merus, with one seta and three serrated spines distally; propodus 1.5 times as long as carpus, with two spines dorsodistally, two serrated spines ventrodistally and some distal spinules, dactylus/unguis shorter than in pereopods 4 and 5.

Pleopods (Fig. 9K) all alike. Basis 1.9 times as long as wide, naked; endopod with one seta subdistally and seven setae distally; exopod just longer than endopod, with nine distal setae. All setae plumose.

Uropod (Fig. 9L) basis 1.5 times as long as wide, naked; exopod about 0.4 times as long as endopod, with one seta subdistally and two setae distally; endopod with only one segment, but with fusion line at three quarters of length, with two penicillate setae at fusion line one long seta subdistally, one short and four long setae distally.

#### Remarks

The appendages of the female and the preparatory male are similar except pleopods that are present in a reduced form only in the male. The copulatory male differs from the female and the preparatory male in the structure and setation of antennules, cheliped and pereopods, in reduction of mouthparts, and well-developed, setose pleopods.

Wi et al. (2015) gave a key to the identification of *Collettea* species; in this, *C. agnesi* fails at couplet 4 as pereonites 2–3 are neither shorter or longer than wide. Unlike *C. agnesi*, the two described species at this point, *C. elongata* Larsen, 2002 and *C. lilliputa* Blazewicz-Paszkowycz & Larsen, 2005, both lack a distinct subdistal ventral expansion on the unguis of pereopods 2–3 (Blazewicz-Paszkowycz and Larsen 2005; Larsen 2002). This unguis expansion is also found in *C. arnaudi* (Shiino, 1978), *C. cylindratoides* Larsen, 2000, or *C. longipleona* Blazewicz-Paszkowycz & Larsen, 2005

(Blazewicz-Paszkowycz and Larsen 2005; Larsen 2000, 2002; Shiino 1978). Moreover, *C. agnesi* differs from *C. elongata* by having only single ventral seta on the cheliped fixed finger and from *C. lilliputa* by having a smooth incisor on the left mandible.

Till this moment, seven species of *Collettea* were described from the Atlantic Ocean, namely *C. bamberi* Drumm & Bird 2016, *C. cylindrata* (Sars, 1882) (Lang, 1971), *C. elongata* Larsen, 2002, *C. minima* (Hansen, 1913), *C. pegmata* Bamber, 2000, *C. rotundicauda* Kudinova-Pasternak, 1983 and *C. wilsoni* Larsen, 1999; and one species (*C. vermiformis* Lang, 1971) from the Mediterranean Sea.

*Collettea agnesi* can be differentiated from those species by:

- a relatively short pleotelson, about as long as the last pleonite. In other Atlantic *Collettea* species, the pleotelson is at least as long as the last three pleonites combined;
- a molar with six distinct teeth. Other Atlantic *Collettea* have molar only with distal serration or spines (Bamber 2000; Drumm and Bird 2016; Hansen 1913; Kudinova-Pasternak 1983; Lang 1971; Larsen 1999, 2002; Sars 1882);
- the fixed finger with two triangular teeth on the cutting edge. Except *C. minima*, the remaining species have only serration on the cutting edge of the fixed finger (Bamber 2000; Drumm and Bird 2016; Hansen 1913; Kudinova-Pasternak 1983; Lang 1971; Larsen 1999, 2002; Sars 1882);
- elongate uropods, distinctly longer than the half of pleotelson. Only in *C. elongata*, uropods are elongate but only close to the half length of pleotelson (Bamber 2000; Drumm and Bird 2016; Hansen 1913; Kudinova-Pasternak 1983; Lang 1971; Larsen 1999, 2002; Sars 1882).

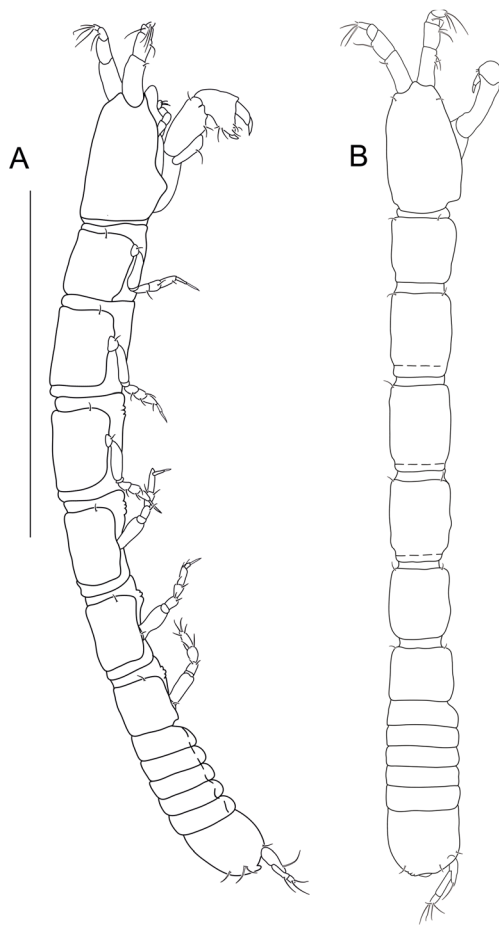
*Collettea agnesi* shares those characters with Antarctic *C. lilliputa* and to some extent also with *C. minima*, and it is possible that those species can be included in the new colletteid genus as previously suggested by Blazewicz-Paszkowycz and Larsen (2005) and Drumm and Bird (2016). At the moment, this species is classified to the genus *Collettea* based on: its cylindrical body, antennule of four articles, antenna of six articles, mandibular molar not pointed, pereopods with coxae, pleopods absent in females, uropod endopod of two segments, and exopod with one segment.

Family Tanaellidae Larsen & Wilson, 2002

Genus *Araphura* Bird & Holdich, 1984

*Araphura studens* n. sp. Blazewicz & Dębiec (Figs 10–12)

Materials examined: holotype non-ovigerous female, 2.3 mm long (ZMBN 116028) st. MA 2-3/1376, sample 4,



**Fig. 10** *Araphura studens* n. sp. n. sp. female holotype (ZMBN 116028), habitus. A lateral view; B dorsal view. Scale bar: 1 mm

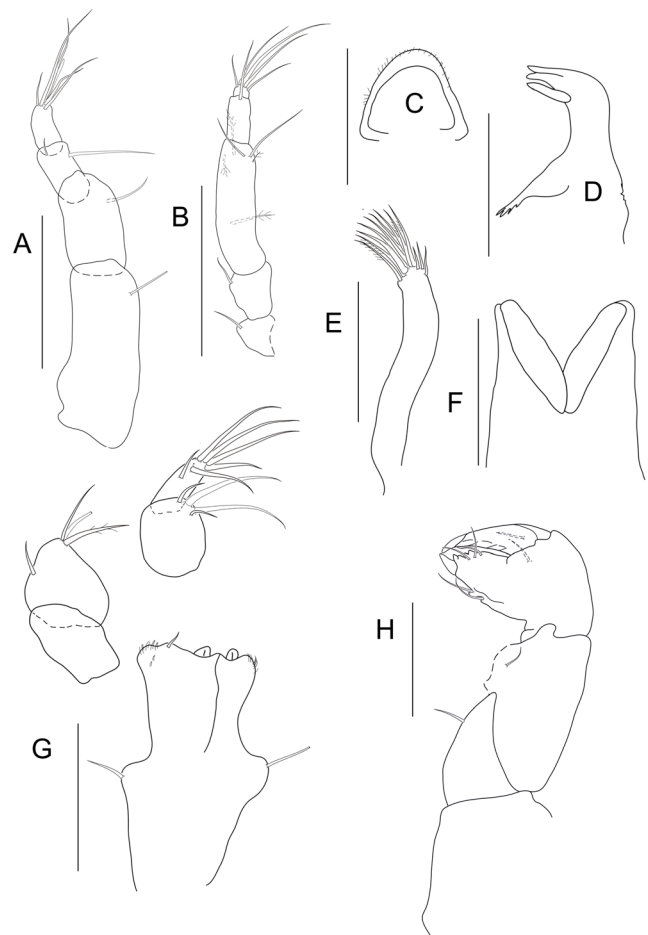
4°30'47.88"N 2°53'26.52"W, depth 1377 m, 22 November 2012; juvenile female, 1.1 mm (ZMBN 116029) st. MA 2-3/1376, sample 4, 4°30'47.88"N 2°53'26.52"W, depth 1377 m, 22 November 2012; paratype non-ovigerous female dissected on slides (ZMBN 116030) st. G7/500, sample 6, 5°30'52.2"N 0°15'29.88"E, depth 504 m, 10 November 2012.

#### Diagnosis

Cephalothorax shorter than pereonites 1 and 2 combined. Pereonites 2–5 elongate. Pleotelson wider than long, as long as last three pleonites combined. Cheliped carpus and dactylus without crenulation. Uropod process reaching over half of endopod first segment.

Etymology: *studens* [lat.] = student; the species is described as a part of a student taxonomical project.

Description of female holotype: body (Fig. 10A, B) slender, about ten times as long as wide. Cephalothorax almost 20% of total body length, elongate, with pair minute setae dorsodistally. Pereonite 1 as long as wide, 0.5 times as long as cephalothorax, with pair of simple dorsodistal setae; pereonites 2–4 subequal, about 1.4 times as long as wide, subrectangular; pereonite 5 about 1.1 times as long as wide; pereonite 6 shortest, about 0.8 times as long as wide. Pleon



**Fig. 11** *Araphura studens* n. sp. female paratype (ZMBN 116030) A antennule; B antenna; C labrum; D left mandible; E maxillule; F labium; G maxilliped; H cheliped. Scale bars: 0.1 mm

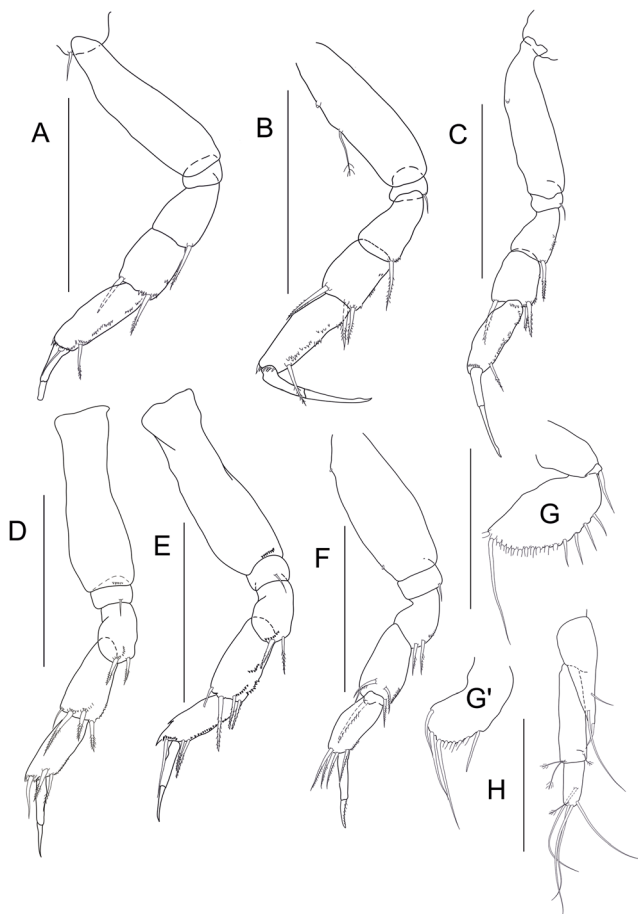
about 20% of total body length. Pleonites subequal, about 0.3 times as long as wide; sterna rounded in lateral profile. Pleotelson almost 20% of total length of pleon, tapering, with four simple distal setae.

Antennule (Fig. 11A) of four articles; proximal article 2.6 times as long as wide, 0.8 times as long as three other articles combined, with one simple distal outer seta; second article about 1.8 times as long as wide, with one subdistal outer simple seta; third article about 2.1 times as long as wide, with two distal setae; fourth article about 2.1 times as long as wide, with group of five simple setae and one aesthetasc distally.

Antenna (Fig. 11B) of six articles; first article not observed; second and third articles with dorsal seta distally; fourth article elongate, about 4.1 times as long as wide, with penicillate seta in the central part, distally with three penicillate setae and two simple setae; fifth article with distal simple seta; sixth article with five simple distal setae.

Mouthparts. Labrum (Fig. 11C) simple, hood shaped and setulose. Left mandible (Fig. 11D) with bifurcated incisor, *lacinia mobilis* simple, tapering distally; molar distally acuminate, with four distal teeth. Maxillule (Fig. 11E) with nine





**Fig. 12** *Araphura studens* n. sp. female paratype (ZMBN 116030) A pereopod 1; B pereopod 2; C pereopod 3; D pereopod 4; E pereopod 5; F pereopod 6; G pleopod basis and exopod; G' pleopod endopod; H uropod. Scale bars: 0.1 mm

distal setae, four of them serrated and with some small setae. Labium (Fig. 11F) simple, without setae. Maxilliped (Fig. 11G) basis with single seta; each endite with one distal seta, one oval tubercle, and microtrichiae on outer distal margin; palp first article naked; second article with three inner setae, at least one of them serrated and one outer seta; third article with four simple setae, two long and two short; fourth article with one subdistal and five distal setae.

Cheliped (Fig. 11H) basis naked, posterior lobe subequal to anterior mass (not shown on figure); merus subtriangular, ventral margin longer than that of carpus, with seta; carpus with ventral single simple seta; propodus robust, 1.2 times as long as wide, with one simple seta on inner face, near dactylus insertion; fixed finger with two simple ventral setae, three simple setae and four teeth on cutting edge; dactylus with one proximal seta.

Pereopod 1 (Fig. 12A) coxa with one seta; basis about 3.7 times as long as wide, naked; ischium naked; merus about 1.8 times as long as wide, with ventrodistal strong serrated seta; carpus with one ventrodistal serrated seta, one serrated dorso-

distal seta and microtrichiae ventrally; propodus with microtrichiae along ventral and distal margins and one ventrodistal serrated seta; dactylus about 0.4 times as long as propodus, with proximal simple seta; unguis broken.

Pereopod 2 (Fig. 12B) basis about 3.2 times as long as wide, with two penicillate setae on dorsal margin; ischium with ventrodistal simple seta; merus about 1.9 times as long as wide, with ventrodistal microtrichiae and one serrated seta; carpus about 1.4 times as long as wide, distally with one dorsal serrated seta, two ventral serrated setae, microtrichiae at midlength of ventral margin; propodus with microtrichiae along ventral margin, row of spinules on distal margin and ventrodistal serrated single seta; dactylus naked; unguis about 1.3 times as long as dactylus, naked.

Pereopod 3 (Fig. 12C) similar to pereopod 2, but basis with one penicillate seta.

Pereopod 4 (Fig. 12D) basis about 6.1 times as long as wide, with microtrichiae distally; ischium with one ventral seta; merus with two serrated setae and microtrichiae distally; carpus about 2.2 times as long as wide, with three serrated seta, one simple seta, and microtrichiae distally; propodus with two serrated ventrodistal setae and one simple dorsodistal seta and microtrichiae distally; dactylus naked, unguis about 0.6 times as long as dactylus, naked.

Pereopod 5 (Fig. 12E) as pereopod 4.

Pereopod 6 (Fig. 12F) basis about 2.4 times as long as wide, with two setae (broken) on dorsal margin; ischium with one seta; merus with microtrichiae and two serrated setae ventrodistally; carpus about 1.8 times as long as wide, with one simple and four serrated setae distally and ventrodistal microtrichiae; propodus about 2.2 times as long as wide, with one ventrodistal and three dorsodistal serrated setae and ventrodistal microtrichiae; dactylus naked; unguis about 0.6 times as long as dactylus, with row of spinules.

Pleopod (Fig. 12G, G') endopod (Fig. 12G') just shorter than exopod, with one subdistal and seven distal setae; exopod (Fig. 12G) with one proximal seta and 16 setae on ventral and distal margins, all setae plumose.

Uropod (Fig. 12H) basal process reaching over half of first endopod segment, with three simple setae; endopod two-segmented, first segment article 2.2 times as long as second segment, with four penicillate setae distally; second segment with one subdistal simple seta and one penicillate and three simple setae distally.

#### Remarks

Using the identification key for species classified within genus *Araphura* (Larsen et al. 2009), *A. studens* n. sp. emerges as *A. brevimanus* (Lilljeborg, 1864). However, those species can be distinguished by a lack of fusion line on the fourth article of antenna, a presence of outer seta on the second article of maxillipedal palp, as well as pereopods 1–3 merus and pereopods 4–6 ischium with only one seta. *Araphura brevimanus* has a distinct fusion line on the fourth article of

antenna, no outer seta on maxilliped palp article 2, pereopods 1–3 merus with two setae, and pereopods 4–6 ischium with two setae (Lilljeborg 1864; Sieg and Dojiri 1989).

Since the publication of Larsen et al. (2009), five more species within *Araphura* have been described (Anderson 2013). Three of them, *Araphura doutagalla* Błażewicz-Paszkowycz & Bamber, 2012, *A. pygmothymos* Błażewicz-Paszkowycz & Bamber, 2012, and *A. yarra* Błażewicz-Paszkowycz & Bamber, 2012, differ from *A. studens* by having a more compact body (all the pereonites are wider than long in *A. doutagalla* and *A. yarra* and pereonite 5 is wider than long in *A. pygmothymos*) (Błażewicz-Paszkowycz and Bamber 2012). Furthermore, the new species differs from the fourth species, *A. macrobelone* Błażewicz-Paszkowycz, Bamber & Cunha, 2011 by having the exopod projection exceeding the half of endopod first article, a single seta on the merus of pereopods 1–3, as well as on the ischium of pereopods 4–6 (two on each segment in *A. macrobelone*), and nine spines on the maxillule endite (eight in *A. macrobelone*) (Błażewicz-Paszkowycz et al. 2011). *Araphura studens* can be also distinguished from *A. whakarakaia* Bird, 2011 by having a smooth cheliped carpus and dactylus (crenulate in the latter species) (Bird 2011).

Except *A. brevimanus* and *A. macrobelone* six more species of *Araphura* were recorded from the Atlantic: *A. arvedlundi* Larsen & Araujo-Silva, 2009, *A. curticauda* Larsen, 2005, *A. extensa* Larsen, 2003, *A. filiformis* (Lilljeborg, 1864), *A. higginsi* Sieg & Dojiri, 1989 and *A. spinitherani* Larsen & Araujo-Silva, 2009. *Araphura studens* can be distinguished from them by the combination of:

- the fourth article of antenna without a fusion line. A fusion line is present in the antenna of *A. arvedlundi*, *A. higginsi*, and *A. spinitherani* (Larsen and Araujo-Silva 2009; Sieg and Dojiri 1989);
- the maxillipedal endite with one seta. *Araphura arvedlundi* and *A. spinitherani* lack setae on endites, while *A. higginsi* has two setae (Larsen and Araujo-Silva 2009; Sieg and Dojiri 1989);
- the second article of maxillipedal palp with outer seta. *Araphura curticauda*, *A. extensa*, and *A. higginsi* lack seta on the second article of palp (Larsen 2003, 2005; Sieg and Dojiri 1989);
- pereopods 1–3 merus with a single seta. Two setae on the merus of those pereopods are present in *A. extensa*, *A. higginsi*, and *A. spinitherani* (Larsen 2003; Larsen and Araujo-Silva 2009; Sieg and Dojiri 1989);
- pereopods 4–6 ischium with one seta. *Araphura arvedlundi* and *A. higginsi* have two setae on the ischium of those pereopods (Larsen and Araujo-Silva 2009; Sieg and Dojiri 1989);
- the basal process of uropod reaching over the half of endopod first segment. The short basal process of uropod is characteristic for: *A. arvedlundi*, *A. curticauda*, *A. extensa*, and *A. filiformis* (Larsen 2003, 2005; Larsen and Araujo-Silva 2009; Lilljeborg 1864). In *A. spinitherani*, the basal process reaches the half of the first segment (Larsen and Araujo-Silva 2009).

**Acknowledgements** The authors thank the crew of RV *Dr. Fridtjof Nansen* and the scientists from Ghana for their assistance in the collecting and processing of the samples. Acknowledgements are extended to the Norwegian Oil for Development programme for financial support of marine environmental monitoring and training of scientific personnel from Ghana, as well as to the Ghanaian Environmental Protection Agency (EPA Ghana). Two anonymous referees have greatly improved the early version of this paper. The studies were supported by the National Science Centre project titled “Bathyal, abyssal and hadal tanaidacean fauna—exploring the deep-sea biodiversity” (2014/13/B/NZ8/04702). The senior author was financed by the Faculty of Biology and Environmental Protection, University of Lodz.

**Open Access** This article is distributed under the terms of the Creative Commons Attribution 4.0 International License (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made.

## References

- Anderson G (2013) Tanaidacea Taxa and Literature. <http://peracarida.usm.edu/>. Accessed 01 Aug 2016
- Bamber RN (2000) New peracarids (Crustacea: Malacostraca) from the Atlantic Deep Sea off Angola. *Spec Divers* 5:317–328
- Bamber RN (2012) Littoral Tanaidacea (Crustacea: Peracarida) from Macaronesia: allopatry and provenance in recent habitats. *JMBA* 92:1095–1116
- Bamber RN, Błażewicz-Paszkowycz M (2013) Another inordinate fondness†: diversity of the tanaidacean fauna of Australia, with description of three new taxa. *J Nat Hist* 47:1767–1789
- Bamber RN, Bird G, Błażewicz-Paszkowycz M, Galil B (2009) Tanaidaceans (Crustacea: Malacostraca: Peracarida) from soft-sediment habitats off Israel, Eastern Mediterranean. *Zootaxa* 2109: 1–44
- Barnard KH (1914a) Contributions to the crustacean fauna of South Africa. 1. Additions to the marine Isopoda. *Ann South African Museum* 10(7):197–230
- Barnard KH (1914b) Contributions to the crustacean fauna of South Africa. 3. Additions to the marine Isopoda with notes on some previously incompletely known species. *Annal South African Museum* 10:325–442
- Barnard KH (1920) Contributions to the crustacean fauna of South Africa. no. 6. Further additions to the list of marine Isopoda. *Annal South African Museum* 17:319–438
- Barnard KH (1935) Report on some Amphipoda, Isopoda, and Tanaidacea in the collections of the Indian Museum. *Rec Indian Mus* 37:279–319
- Bird GJ (2004) Tanaidacea (Crustacea) of the Northeast Atlantic: non-filiform species of Anarthruridae Lang from the Atlantic Margin. *Zootaxa* 471:1–44

- Bird GJ (2007a) Family incertae cedis. In: Larsen K, Shimomura M (eds) Tanaidacea (Crustacea: Peracarida) From Japan III. the Deep Trenches: the Kurile-Kamchatka Trench and Japan Trench. Magnolia Press, Auckland, pp 121–149
- Bird GJ (2007b) Families Anarthruridae Lang, 1971, Colletteidae Larsen & Wilson, 2002, and Leptognathiidae Sieg, 1976. In: Larsen K, Shimomura M (eds) Tanaidacea (Crustacea: Peracarida) from Japan III. the deep trenches: the Kurile-Kamchatka Trench and Japan Trench. Magnolia Press, Auckland, pp 61–85
- Bird GJ (2011) Paratanaoidean tanaidaceans (Crustacea: Peracarida) from littoral and shallow sublittoral habitats in New Zealand, with descriptions of three new genera and seven new species. *Zootaxa* 2891:1–62
- Bird GJ (2015) Tanaidacea (Crustacea: Peracarida) of the northeast Atlantic: *Chauliopeleona* Dojiri and Sieg, 1997 and *Saurotipleona* n. gen. from the ‘Atlantic Margin’. *J Nat His* 49:1507–1547
- Bird GJ, Holdich DM (1984) New deep-sea leptognathiid tanaiids (Crustacea, Tanaidacea) from the north-east Atlantic. *Zool Scr* 13: 285–315
- Błażewicz-Paszkwowycz M, Bamber RN (2011) Tanaidomorph Tanaidacea (Crustacea: Peracarida) from mud-volcano and seep sites on the Norwegian Margin. *Zootaxa* 3061:1–35
- Błażewicz-Paszkwowycz M, Bamber RN (2012) The Shallow-water Tanaidacea (Arthropoda: Malacostraca: Peracarida) of the Bass Strait, Victoria, Australia (other than the Tanaidae). *Mem Mus Vic* 69:1–235
- Błażewicz-Paszkwowycz M, Larsen K (2005) New species of the genus *Collettea* Lang, 1973 (Paracarida: Tanaidacea, Colletteidae) from the Antarctic. *Zootaxa* 1085:1–19
- Błażewicz-Paszkwowycz M, Bamber RN, Cunha MR (2011) New tanaidomorph Tanaidacea (Crustacea: Peracarida) from submarine mud-volcanoes in the Gulf of Cadiz (North-east Atlantic). *Zootaxa* 2769: 1–53
- Błażewicz-Paszkwowycz M, Bamber RN, Józwiak P (2013) Tanaidaceans (Crustacea: Peracarida) from the SoJaBio joint expedition in slope and deeper waters in the Sea of Japan. *Deep-Sea Res II* 111:325–332. doi:10.1016/j.dsr2.2014.08.021
- Bochert R (2012) Apseudomorph Tanaidacea from the continental shelf of Angola and Namibia with descriptions of three new species. *Zootaxa* 3583:31–50
- Brown AC (1954) An addition to the South African Tanaidacea. *Ann Mag Nat Hist* 7:939–942
- Brown AC (1956a) A new species of *Kalliapseudes* (Tanaidacea) from South Africa. *Ann Mag Nat Hist* 9:582–585
- Brown AC (1956b) Additions to the genus *Apseudes* (Crustacea: Tanaidacea) from South Africa. *Ann Mag Nat Hist Ser* 12(9):705–709
- Brown AC (1957a) A revision of the genus *Leptochelia* (Crustacea: Tanaidacea) in southern African waters. *Ann Mag Nat Hist* 10: 401–408
- Brown AC (1957b) On an interesting new tanaidacean crustacean from the west coast of South Africa, *Tanaiomera columbina*, gen. nov., sp. nov. *Ann Mag Nat Hist* 10:817–820
- Brown AC (1958) Report on the tanaidacean Crustacea of the Langebaan Lagoon and Saldanha Bay, on the west coast of South Africa. *Ann Mag Nat Hist* 13(1):453–458
- Coleman CO (2003) “Digital inking”: how to make perfect line drawings on computers. *Org Divers Evol* 14:1–14
- Dojiri M, Sieg J (1997) 3. The Tanaidacea. In: Blake JA, Scott PH (eds) Taxonomic Atlas of the Benthic Fauna of the Santa Maria Basin and Western Santa Barbara Channel. Volume 11. The Crustacea Part 2. The Isopoda, Cumacea and Tanaidacea. Santa Barbara Museum of Natural History, Santa Barbara, pp 181–278
- Dollfus A (1898) Campagnes de la Melita. Tanaiidae récoltés par M. Ed. Chevreux dans l’Atlantique et dans la Méditerranée. *Mémoires de la Société Zoologique de France* 11:35–47
- Drumm DT, Bird GJ (2016) New deep-sea Paratanaoidea (Crustacea: Peracarida: Tanaidacea) from the northeastern Gulf of Mexico. *Zootaxa* 4154: 389–414. doi:10.11646/zootaxa.4154.4.2
- Guerrero-Kommritz J (2003a) Agathotanaididae (Crustacea: Tanaidacea) from the Angola Basin. *Zootaxa* 330:1–15
- Guerrero-Kommritz J (2003b) *Portarartrum*, a new genus of deep-sea Tanaidacea (Crustacea) with description of two new species. *Zootaxa* 282:1–14
- Guerrero-Kommritz J (2004) A revision of the genus *Paraleptognathia* Kudinova-Pasternak, 1981 (Crustacea: Tanaidacea) and description of four new species. *Zootaxa* 481:1–63
- Guerrero-Kommritz J, Błażewicz-Paszkwowycz M (2004) New species of *Tanaella* Norman and Stebbing, 1886 (Crustacea: Tanaidacea: Tanaellidae) from the deep-sea off the Antarctic and the Angola Basin, with a key to the genus. *Zootaxa* 459:1–20
- Guerrero-Kommritz J, Heard RW (2003) A new genus and species of deep-sea apseudomorph tanaidacean (Crustacea: Malacostraca: Peracarida) from the Angola Basin. *Mitt Hambg Zool Mus Inst* 100:127–137
- Guerrero-Kommritz J, Schmidt A, Brandt A (2002) *Paranarthrura* Hansen, 1913 (Crustacea: Tanaidacea) from the Angola Basin, description of *Paranarthrura angolensis* n. sp. *Zootaxa* 116:1–12
- Hansen HJ (1913) Crustacea, Malacostraca. II. IV. the Order Tanaidacea. *Danish Ingolf Expedit* 3:1–145
- Jakiel A, Stepien A, Józwiak P, Serigstad B, Błażewicz-Paszkwowycz M (2015) First record of Tanaidacea (Crustacea) from a deep-sea coral reef in the Gulf of Guinea. *Zootaxa* 3995: 203–228. doi:10.11646/zootaxa.3995.1.18.
- Kudinova-Pasternak RK (1983) The abyssal Tanaidacea (Crustacea) of the Iberian and west-european hollows of the Atlantic Ocean. *Zoologicheskii Zhurnal* 62:1170–1176
- Kudinova-Pasternak RK (1990) Tanaidacea (Crustacea, Malacostraca) of the southeastern part of Atlantic Ocean and the region to the north off Mordvinov (Elephant) Island. *T I Ocean* 126:90–107
- Lang K (1955) Tanaidacea from tropical West Africa. In: Bruun AF (ed) Atlantide report no. 3- scientific results of the Danish expedition to the coasts of tropical West Africa 1945–1946. Dan Sci Press, Copenhagen, pp 57–81
- Lang K (1956) Kalliapseudidae, a new family of Tanaidacea. In: Wingstrand KG (ed) Bertil Hanström; Zoological Papers in Honour of his Sixty-fifth Birthday, November 20th, 1956. Zoological Institute, Lund, pp 205–225
- Lang K (1968) Deep-Sea Tanaidacea. In: Galathea Report, Vol. 9. Danish Science Press, Copenhagen, pp 23–210
- Lang K (1971) Taxonomische und phylogenetische Untersuchungen über die Tanaidaceen. 7. revision der Gattung *Strongylura* G.O. Sars, 1882, nebst Beschreibung einer neuen Art dieser Gattung. *Arkiv för Zool* 23:403–415
- Lang K (1972) *Siphonolabrum mirabile* n. gen., n. sp. (Tanaidacea). *Crustaceana* 3:214–220
- Larsen K (1999) Deep-sea tanaidaceans (Crustacea: Peracarida) from the Albatross cruises 1885–86, with keys to the suborder Neotanaidomorpha. *J Nat Hist* 33:1107–1132
- Larsen K (2000) Revision of the genus *Collettea* (Crustacea: Tanaidacea). *Invertebr Taxon* 14:681–693
- Larsen K (2002) Tanaidacea (Crustacea: Peracarida) of the Gulf of Mexico. X. the question of being male. *Gulf Caribb Res* 14:53–56
- Larsen K (2003) The tanaidacean fauna (Peracarida) from a deep-sea cold-seep in the Gulf of Mexico. *J Crustacean Biol* 23:777–794
- Larsen K (2005) Deep-Sea Tanaidacea (Peracarida) from the Gulf of Mexico. Brill, Leiden
- Larsen K (2012) Tanaidacea (Peracarida) from Macaronesia I. the deep-water fauna off the Selvagen Islands, Portugal. *Crustaceana* 85:571–589

- Larsen K, Araújo-Silva CL (2014) The ANDEEP Tanaidacea (Crustacea: peracarida) revisited III: the family Akanthophoreidae. *Zootaxa* 3796:237–264
- Larsen K, de Araújo-Silva C L, Coelho PA (2009) Tanaidacea from Brazil. I. the family Tanaellidae Larsen & Wilson, 2002. *Zootaxa* 2141:1–19
- Larsen K, Nagaoka R, Froufe E (2012) Tanaidacea (Crustacea) from Macaronesia III. the shallow-water Tanaidomorpha from the Cape Verde archipelago. *Zootaxa* 3498:24–44
- Lilljeborg W (1864) Bidrag til kännedomen om de inom Sverige och Norrige förekommande Crustaceer af Isopodernas underordning och Tanaidernas familj. Inbjudningsskrift till Åhörande av de Offentliga Föreläsningar. Uppsala Univ Årsskrift 1865:1–31
- Sars GO (1882) Revision af gruppen: Isopoda Chelifera med karakteristik af nye herhen hørende arter og slægter. *Arch Matematik og Naturvidenskab* 7:1–54
- Serigstad B, Ensrud T, Olsen M, Ostrowski M, Appoh E, Adu-Kumi S, Akoto L, Aggrey-Fynn J, Błazewicz-Paszkowycz M, Józwiak P, Pabis K, Siciński J (2015) Environmental monitoring Ghana 2012. Chemical and biological analysis. Centre for Development and Cooperation in Fisheries, Bergen
- Shiino SM (1978) Tanaidacea collected by French Scientists on board the survey ship “Marion-Dufresne” in the regions around the Kerguelen Islands and other subantarctic islands in 1972, '74, '75, '76. *Sci Rep Shima Marin* 5:1–122
- Sieg J, Dojiri M (1989) Remarks on *Araphura* Bird & Holdich (Crustacea, Tanaidacea) and allied genera, including descriptions of three new species. *Zool Scr* 18:115–137
- Sieg J, Dojiri M (1991) Two new species and a new genus of the suborder Tanaidomorpha (Crustacea: Tanaidacea) from Californian waters. *J Nat Hist* 25:1493–1512
- Vanhöffen E (1914) Die Isopoden der deutschen Südpolar-Expedition 1901–1903. *Deutsche Südpolar-Expedition* 15:447–598
- Weigmann S, Guerrero-Kommritz J (2009) New species of *Neotanais* Beddard, 1886 (Crustacea, Tanaidacea) from the deep sea of the tropical and southern East Atlantic Ocean. *Zootaxa* 1992:20–36
- Wi JH, Suh HL, Kim D (2015) Three new species of the deep-sea genus *Collettea* Lang, 1973 (Tanaidacea; Colletteidae) in the eastern Central Pacific. *J Crustacean Biol* 35:714–727